



LU 6036

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Roland Kratzer : Group Art Unit: 1796

Ser. No. 10/521,073 : Examiner: Caixia Lu

Filed: July 6, 2005

For: PREPARATION OF SUPPORTED :  
CATALYST SYSTEMS :

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Sir:

Please enter the following Brief in response to the final Office action mailed April 14, 2008 and the Advisory action mailed November 18, 2008. Appellants filed a Notice of Appeal on October 14, 2008. The Office has been authorized to charge Deposit Account No. 08-2336 for the requisite fees for this Brief and for a four-month time extension.

I. Real Party in Interest

The real party in interest for the application is Basell Polyolefine GmbH, Bruhler Strasse 60, 50389 Wesseling, Germany, a company of LyondellBasell Industries, with headquarters at P.O. Box 2416, 3000 CK Rotterdam, The Netherlands.

II. Related Appeals and Interferences

There are no other prior or pending appeals, interferences, or judicial proceedings known to Appellants, Appellants' legal representative, or the assignee which may relate to, directly affect, or be directly affected by or have a bearing on the Board's decision in this appeal.

### III. Status of Claims

Claims 21-40 stand rejected and are being appealed.

### IV. Status of Amendments

No amendment was filed subsequent to the final rejection.

### V. Summary of Claimed Subject Matter

Claim 21, the only independent claim, defines a process for preparing a catalyst solid useful for olefin polymerization. The catalyst solid is made by contacting, without isolation of an intermediate, each of five components: (a) an organic transition metal compound; (b) an organometallic compound of a particular formula; (c) an organic compound having a functional group comprising an active hydrogen; (d) a Lewis base; and (e) a support.

Common approaches to making metallocene catalysts involve at least one step and typically multiple steps of isolation of an intermediate component via a workup step. One or more constituents of the reaction mixture is separated from other components by filtering, washing, distillation, or drying. Often, the support is treated with activators and is isolated in dry form before combination with a metallocene complex (see Application, p. 2, ll. 17-22).

Appellants surprisingly found that one particular class of supported metallocene catalysts, i.e., the type made from components (a) through (e) specified above, can be improved considerably (see Examples 1-6 and Comparison Examples A and B) by using a one-pot preparation strategy in which no intermediate components are isolated. In particular, Appellants found that catalysts with improved productivity for making polyolefins, particularly polypropylene, result from use of the one-pot process, thereby enabling use of reduced levels of expensive components such as (a) and (c).

## VI. Grounds of Rejection to be Reviewed on Appeal

1. Whether claims 21-40 are unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Bohnen et al. (WO 99/40129, equivalent to U.S. Pat. No. 6,482,902, hereinafter “the ‘902 patent”) and Bohnen et al. (WO 99/06414, equivalent to U.S. Pat. No. 6,417,302, hereinafter “the ‘302 patent”).

## VII. Argument

### The Combined Teachings of Bohnen ‘902 and Bohnen ‘302 Do Not Make it Obvious to Make the Specifically Claimed Supported Catalysts Without Isolating An Intermediate Component

The ‘902 and ‘302 patents both relate to the preparation of metallocene catalysts useful for making olefin polymers. However, for the reasons outlined below, the combined reference teachings fail to make it obvious to make the specifically claimed supported catalysts without isolating an intermediate.

#### A. Bohnen ‘902 Describes Only Processes in which an Intermediate is Isolated, and is Therefore the Opposite of a One-Pot Approach

Bohnen ‘902 describes catalyst systems that may incorporate components (a) through (e) of Appellants’ claim 21, but an intermediate is always isolated prior to having all of the components present. The Examiner has acknowledged that the ‘902 patent “does not expressly disclose . . . combining all of the catalyst components without any isolation of an intermediate” (Office action, p. 2). Not only does the reference not “expressly” disclose a one-pot approach, it nowhere discloses even a single example in which a one-pot approach is taught or suggested. In every example, an intermediate is isolated.

Example 5 of the ‘902 patent is typical. There, a silica support is combined with toluene and N,N-dimethylaniline (the Lewis base of Appellants’ claim 21) to give a slurry. A mixture of a reaction product of trimethylaluminum (component (b)) and bis(pentafluorophenyl)borinic acid (component (c)) from Example 1 are added to the silica slurry, and the mixture is filtered, washed, and

dried. Thus, a prepared, activated support is produced and isolated prior to its combination with a metallocene complex (see Example 9).

The pattern repeats throughout the examples of Bohnen '902. The skilled person must therefore view the '902 patent as teaching the need to isolate an intermediate, i.e., the treated support, prior to its combination with the transition metal compound (component (a)). The sequence of steps is more complicated than simply combining the reactants in one pot. The skilled person must conclude that it is necessary to isolate intermediate components to make an acceptable supported catalyst. Otherwise, why bother with the extra work?

B. Combining the '902 Patent with Bohnen '302 Fails to Make a One-Pot Process Obvious

Recognizing the weakness of the '902 disclosure, the Examiner combined its teachings with Bohnen '302, another similar reference describing the preparation of certain metallocene complexes. However, as discussed below, the combined reference teachings fail to make a one-pot process obvious.

1. Bohnen '302 Omits the Lewis Base

The catalysts described in Bohnen '302 lack the Lewis base required of catalysts made by the claimed process. The Examiner commented that because the Lewis base should not interfere with forming a catalyst (given Bohnen '902), a skilled person would have expected success in a one-pot approach to making a catalyst according to the '302 patent as modified by inclusion of the Lewis base (Office action, p. 3). Appellants respectfully disagree. For reasons provided in the next two sections below, the '302 patent does not reasonably suggest the claimed one-step process for making supported catalysts without isolation of an intermediate. Moreover, had Appellants (for whatever reason) omitted the Lewis base from their own comparative examples, the Office surely would have insisted on seeing a "fair" comparison in which both the examples (showing a one-pot catalyst preparation) and the comparative examples (showing stepwise preparation with isolation of intermediates) were performed in the presence of the

Lewis base. Thus, the Examiner should not now presume that Bohnen '302's lack of a teaching to use a Lewis base can be overlooked.

2. Only Example 7 of Bohnen '302 Relates to Supported Catalysts

The Examiner stated that the '302 patent "teaches a similar catalyst composition by combining all of the catalyst components to provide a catalyst solid without any isolation of the intermediate in a "one-pot" synthesis (Examples 1-7, col. 1, line 1 to col. 6, line 49)"; Office action, p. 2. Appellants respectfully disagree. The reference to "col. 1, line 1 to col. 6, line 49" is too broad to help anyone identify which portion of the '302 patent, if any, relates to a one-pot process. The reference to Examples 1-7 is more specific and therefore potentially more helpful, so a closer look is warranted.

Examples 1-4 relate to the preparation of stock solutions that are reaction products of alkylaluminum compounds and bis(aryl)borinic acids; obviously, no support is included in these compositions. Examples 5 and 6 describe the preparation of an unsupported catalyst system prepared from the stock solution of Example 1 and its use in an ethylene polymerization process. Because Appellants' claimed catalyst preparation requires a support, Examples 5 and 6 can be ignored.

Only Example 7 relates to a supported catalyst. Here, silica is added to a mixture of the co-catalyst stock solution from Example 1 and a solution of the metallocene complex. Removal of solvents gives the supported catalyst. As is discussed in more detail below, the use of filtration in Example 1 and the preparation of a stock solution distinguish these examples from Appellants' claimed process. Thus, in the only example of the '302 patent that makes a supported catalyst, a one-pot approach "without any isolation of an intermediate" is not used.

3. Bohnen '302 Teaches Filtration and Use of a Stock Solution, Which Are Isolation Steps

In Examples 1 and 2 of Bohnen '302, the reaction product is "filtered through a G4 frit, giving a clear, pale yellow solution . . . ." This contrasts with Appellants' claimed process in which filtration and other separation techniques

are intentionally avoided. Appellants teach that their process “is carried out by bringing the components A) to E) into contact with one another without any work-up of the mixtures present at intermediate stages” (Application, p. 25). “Work-up” involves “a separation step in which one or more constituents of the reaction mixture are separated from other constituents of the mixture . . . for example by filtration, washing, distillation, or drying” (Application, p. 26).

Moreover, the “stock solution” of Bohnen ‘302 is inherently at odds with the idea of a “one pot” process for making a supported catalyst. By their nature, stock solutions are prepared in advance and may be stored indefinitely. The skilled person appreciates that combining the support, complex, Lewis acid, and other components with a stock solution prepared by pre-reacting an organoaluminum compound and a bis(aryl)borinic acid will likely produce different results from an alternative process in which all of the components are combined in one pot. In fact, making a stock solution isolates an intermediate product because it pre-reacts two components--in this case the organoaluminum compound and the bis(aryl)borinic acid--that may not react the same way in the presence of other components, as in a one-pot approach.

C. The Combined References Do Not Suggest Improved Catalyst Productivity From a One-Pot Approach

1. Neither Reference Suggests a One-Pot Approach

It can hardly be said that either reference (or their combination) suggests using a one-pot approach to catalyst preparation, despite the Examiner’s characterization of the ‘302 disclosure as a one-pot process. The Examiner argued that a skilled person would gravitate toward the claimed process because of the availability of fewer steps and a lower production cost. Indeed, those are expected benefits of the claimed process. Contrary to the Examiner’s assertion, however, the combined references point the skilled person more in the direction of a stepwise approach to catalyst preparation. First, the ‘902 patent is the only reference to describe a catalyst system made from the same reactants because the ‘302 patent is missing the Lewis base. Second, all of the examples from the

'902 patent teach to add the metallocene complex last, and only after isolating and drying a support treated with other components. A skilled person would not ignore this consistent teaching to isolate a treated support first. Third, the '302 patent is mischaracterized as a "one pot" process because of the filtration step used in making the aluminoboron cocatalyst (Examples 1 and 2) and also for the use of a "stock solution" (Examples 1-4) as discussed above. Finally, the '302 patent has limited teachings related to supported catalysts. Overall, its teachings are at least as consistent, if not more so, with a stepwise approach to catalyst preparation.

## 2. The Office Ignored Demonstrated Productivity Advantages

The Office action (p. 2) urges that Appellants have not demonstrated criticality in the one-pot catalyst preparation or shown unexpected results. Appellants respectfully disagree.

First, as Examples 1-2 versus Comparative Examples A-B demonstrate, the one-pot process enables using reduced levels of expensive components such as (a) and (c). Note that the productivities expressed either in terms of kg PP/mmol boron or kg PP/mmol Zr-h are a factor of four greater when the one-pot process is employed. Thus, much less metallocene or boron activator is needed to give the same effect if the catalyst is prepared by the claimed process.

The Examiner should also reconsider the results of Examples 3-4 versus Comparative Examples A-B. Here, the same reactants (trimethylaluminum, bis(pentafluorophenyl)borinic acid, N,N-dimethylbenzylamine, silica, and toluene solvent) are used to make a silica-supported catalyst, but in Example 3 a one-pot approach is used, while Comparative Example A shows the more typical stepwise process. The initial step in each involves combining trimethylaluminum and the borinic acid compound in toluene. In Example 3, additional components are added sequentially in the same pot, while in Comparative Example A, a treated support is isolated by filtration, washed, and dried prior to contacting it with the metallocene complex. As the polymerization results (Example 4 and Comparative Example B) show, the supported complex prepared in Example 3 is far more productive in making polypropylene than the supported complex

prepared in Comparative Example A (740 kg PP/mmol Zr-h versus 25.5 kg PP/mmol Zr-h for the control).

At best, the combined teachings of Bohnen '902 and Bohnen '302 would only have predicted *equivalent productivities* from these catalysts, with (as the Examiner indicates) perhaps a possible edge in simplicity and production cost for the one-pot approach. The Office may not ignore such evidence of an unexpected benefit arising from the claimed catalyst preparation process, which rebuts any prima facie showing of obviousness based on combined teachings.

#### VIII. Conclusion

Appellants respectfully ask the Board of Appeals and Interferences to reconsider and reverse the Section 103(a) rejection because the combined teachings of Bohnen '902 and '302 fail to make Appellants' claimed catalyst preparation process obvious.

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first-class mail, with sufficient postage, in an envelope addressed to: Commissioner for Patents, P.O. Box. 1450, Alexandria, VA 22313-1450 on April 9, 2009.

Jonathan L. Schuchardt  
Name of person signing

Jonathan L. Schuchardt  
Signature

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Respectfully submitted,

Roland Kratzer

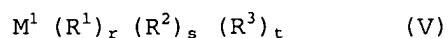
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April 9, 2009

### VIII. Claims Appendix

**21.** A process for preparing a catalyst solid for olefin polymerization by contacting, without any isolation of an intermediate,

- (A) at least one organic transition metal compound;
- (B) at least one organometallic compound of formula (V)



where

$M^1$  is an alkali metal, an alkaline earth metal, or a metal of group 13 of the Periodic Table;

$R^1$  is hydrogen,  $C_1$ - $C_{10}$ -alkyl,  $C_6$ - $C_{15}$ -aryl, halo- $C_1$ - $C_{10}$ -alkyl, halo- $C_6$ - $C_{15}$ -aryl,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -alkylaryl,  $C_1$ - $C_{10}$ -alkoxy, halo- $C_7$ - $C_{40}$ -alkylaryl, halo- $C_7$ - $C_{40}$ -arylalkyl, or halo- $C_1$ - $C_{10}$ -alkoxy;

$R^2$  and  $R^3$  are each hydrogen, halogen,  $C_1$ - $C_{10}$ -alkyl,  $C_6$ - $C_{15}$ -aryl, halo- $C_1$ - $C_{10}$ -alkyl, halo- $C_6$ - $C_{15}$ -aryl,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -alkylaryl,  $C_1$ - $C_{10}$ -alkoxy, halo- $C_7$ - $C_{40}$ -alkylaryl, halo- $C_7$ - $C_{40}$ -arylalkyl, or halo- $C_1$ - $C_{10}$ -alkoxy;

$r$  is an integer from 1 to 3; and

$s$  and  $t$  are integers from 0 to 2, where the sum  $r+s+t$  corresponds to the valence of  $M^1$ ;

- (C) at least one organic compound comprising at least one functional group comprising active hydrogen, wherein the functional group is selected from the groups consisting of hydroxyl group, primary and secondary amino groups, mercapto groups, silanol groups, carboxyl groups, amido groups, and imido groups;
- (D) at least one Lewis base; and
- (E) at least one support.

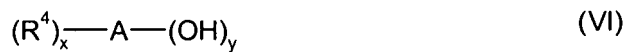
**22.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **21**, wherein the component (B) is a mixture of at least two different organometallic compounds.

23. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 22, wherein the component (B) is a mixture of at least one aluminum-containing organometallic compound and at least one boron-containing organometallic compound.

24. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 22, wherein the component (B) comprises at least two different aluminum-containing organometallic compounds.

25. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 21, wherein the organic compound of component (C) comprises at least one hydroxyl group.

26. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 25, wherein the component (C) is a compound of formula (VI)



where

A is an atom of group 13, 14 or 15 of the Periodic Table, or a group comprising from 2 to 20 carbon atoms;

$R^4$  are identical or different, and are each independently of one another, hydrogen, halogen,  $C_1$ - $C_{20}$ -alkyl,  $C_1$ - $C_{20}$ -haloalkyl,  $C_1$ - $C_{10}$ -alkoxy,  $C_6$ - $C_{20}$ -aryl,  $C_6$ - $C_{20}$ -haloaryl,  $C_6$ - $C_{20}$ -aryloxy,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -haloarylalkyl,  $C_7$ - $C_{40}$ -alkylaryl,  $C_7$ - $C_{40}$ -haloalkylaryl, or  $OSiR_3^5$ ; where

$R^5$  are identical or different, and are each independently of one another, hydrogen, halogen,  $C_1$ - $C_{20}$ -alkyl,  $C_1$ - $C_{20}$ -haloalkyl,  $C_1$ - $C_{10}$ -alkoxy,  $C_6$ - $C_{20}$ -aryl,  $C_6$ - $C_{20}$ -haloaryl,  $C_6$ - $C_{20}$ -aryloxy,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -haloarylalkyl,  $C_7$ - $C_{40}$ -alkylaryl, or  $C_7$ - $C_{40}$ -haloalkylaryl;

y is at least 1; and

x is an integer from 0 to 41.

27. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 23, wherein the component (B) comprises at least two different aluminum-containing organometallic compounds.

28. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 27, wherein the organic compound of component (C) comprises at least one hydroxyl group.

29. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 28, wherein the component (C) is a compound of formula (VI)



where

A is an atom of main group 13, 14 or 15 of the Periodic Table, or a group comprising from 2 to 20 carbon atoms;

$R^4$  are identical or different, and are each independently of one another, hydrogen, halogen,  $C_1$ - $C_{20}$ -alkyl,  $C_1$ - $C_{20}$ -haloalkyl,  $C_1$ - $C_{10}$ -alkoxy,  $C_6$ - $C_{20}$ -aryl,  $C_6$ - $C_{20}$ -haloaryl,  $C_6$ - $C_{20}$ -aryloxy,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -haloarylalkyl,  $C_7$ - $C_{40}$ -alkylaryl,  $C_7$ - $C_{40}$ -haloalkylaryl, or  $OSiR_3^5$ , where

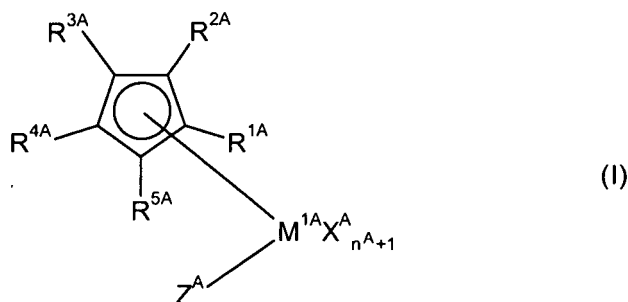
$R^5$  are identical or different, and are each independently of one another, hydrogen, halogen,  $C_1$ - $C_{20}$ -alkyl,  $C_1$ - $C_{20}$ -haloalkyl,  $C_1$ - $C_{10}$ -alkoxy,  $C_6$ - $C_{20}$ -aryl,  $C_6$ - $C_{20}$ -haloaryl,  $C_6$ - $C_{20}$ -aryloxy,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -haloarylalkyl,  $C_7$ - $C_{40}$ -alkylaryl, or  $C_7$ - $C_{40}$ -haloalkylaryl;

y is at least 1; and

x is an integer from 0 to 41.

30. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 28, wherein the component (A) comprises at least one cyclopentadienyl-type ligand.

31. The process for preparing a catalyst solid for olefin polymerization as claimed in claim 21, wherein the component (A) is of formula (I)



wherein  
 $M^{1A}$

is titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum or tungsten, or an

element of group 3 or lanthanides of the Periodic Table;

$X^A$  are identical or different, and are each independently of one another, fluorine, chlorine, bromine, iodine, hydrogen,  $C_1$ - $C_{10}$ -alkyl,  $C_2$ - $C_{10}$ -alkenyl,  $C_6$ - $C_{15}$ -aryl,  $C_7$ - $C_{40}$ -alkylaryl,  $C_7$ - $C_{40}$ -arylalkyl,  $-OR^{6A}$ , or  $-NR^{6A}R^{7A}$ , or two  $X^A$  radicals are joined to for a substituted or unsubstituted diene ligand;

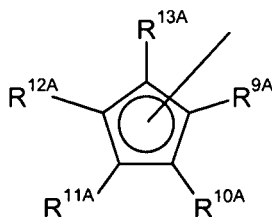
$R^{6A}$  and  $R^{7A}$  are identical or different, and are each independently of one another,  $C_1$ - $C_{10}$ -alkyl,  $C_6$ - $C_{15}$ -aryl,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -alkylaryl, fluoroalkyl, fluoroaryl, wherein the  $C_7$ - $C_{40}$ -arylalkyl or  $C_7$ - $C_{40}$ -alkylaryl comprise from 1 to 19 carbon atoms in the alkyl radical and from 6 to 21 carbon atoms in the aryl radical;

$n^A$  is 1, 2 or 3, where  $n^A$  is such that component (A) of formula (I) is uncharged;

$R^{1A}$  to  $R^{5A}$  are identical or different, and are each independently of one another, hydrogen,  $C_1$ - $C_{22}$ -alkyl, 5- to 7-membered cycloalkyl or cycloalkenyl which optionally bear  $C_1$ - $C_{10}$ -alkyl groups as substituents,  $C_2$ - $C_{22}$ -alkenyl,  $C_6$ - $C_{22}$ -aryl,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -alkylaryl,  $-NR^{8A}_2$ ,  $-N(SiR^{8A}_3)_2$ ,  $-OR^{8A}$ ,  $-OSiR^{8A}_3$ ,  $-SiR^{8A}_3$ , where the radicals  $R^{1A}$  to  $R^{5A}$  may optionally be substituted by at least one halogen, or two radicals  $R^{1A}$  to  $R^{5A}$ , in particular adjacent radicals, together with the atoms connecting them are joined to form a five-, six- or seven-membered ring, or a five-, six- or seven-membered heterocycle comprising at least one atom selected from the group consisting of N, P, O and S;

$R^{8A}$  are identical or different, and are each independently of one another,  $C_1$ - $C_{10}$ -alkyl,  $C_3$ - $C_{10}$ -cycloalkyl,  $C_6$ - $C_{15}$ -aryl,  $C_1$ - $C_4$ -alkoxy, or  $C_6$ - $C_{10}$ -aryloxy; and

$Z^A$  is as defined for  $X^A$ , or is

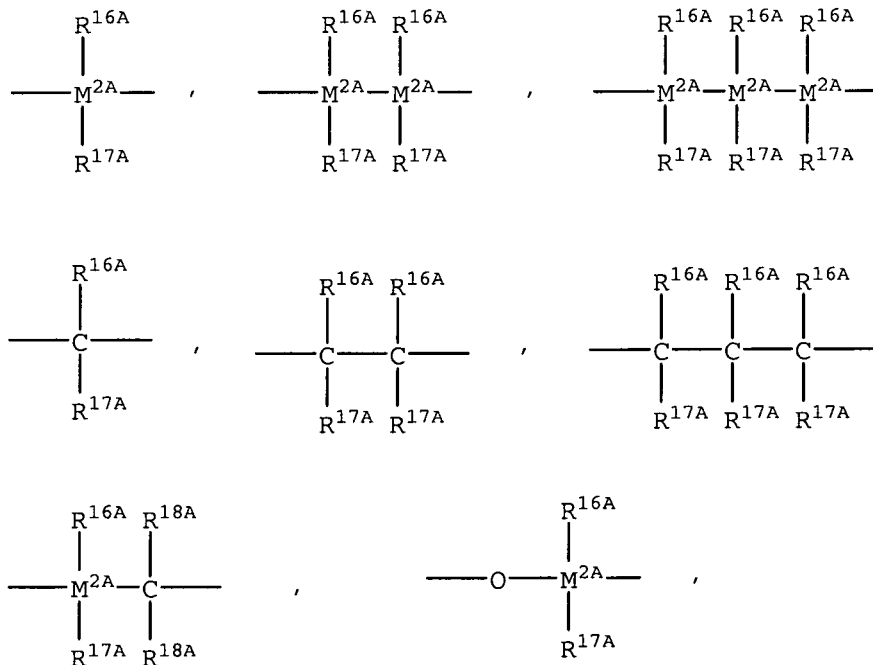


where

$R^{9A}$  to  $R^{13A}$  are identical or different, and are each independently of one another, hydrogen,  $C_1$ - $C_{22}$ -alkyl, 5- to 7-membered cycloalkyl or cycloalkenyl which optionally bear  $C_1$ - $C_{10}$ -alkyl groups as substituents,  $C_2$ - $C_{22}$ -alkenyl,  $C_6$ - $C_{22}$ -aryl,  $C_7$ - $C_{40}$ -arylalkyl,  $C_7$ - $C_{40}$ -alkylaryl,  $-NR^{14A}_2$ ,  $-N(SiR^{14A}_3)_2$ ,  $-OR^{14A}$ ,  $-OSiR^{14A}_3$ , or  $-SiR^{14A}_3$ , where  $R^{9A}$  to  $R^{13A}$  may also be substituted by halogen, and/or two radicals  $R^{9A}$  to  $R^{13A}$  together with the atoms connecting them may be joined to form a five-, six- or seven-membered ring, or a five-, six- or seven-membered heterocycle comprising at least one atom selected from the group consisting of N, P, O and S;

$R^{14A}$  are identical or different, and are each independently of one another,  $C_1$ - $C_{10}$ -alkyl,  $C_3$ - $C_{10}$ -cycloalkyl,  $C_6$ - $C_{15}$ -aryl,  $C_1$ - $C_4$ -alkoxy, or  $C_6$ - $C_{10}$ -aryloxy, or  $R^{4A}$  and  $Z^A$  together form an  $-R^{15A}_vA-A^A-$  group, where

$R^{15A}$  is



$-BR^{16A}-$ ,  $-(BNR^{16A}R^{17A})-$ ,  $-AlR^{16A}-$ ,  $-Ge-$ ,  $-Sn-$ ,  $-O-$ ,  $-S-$ ,  $-SO-$ ,  
 $-SO_2-$ ,  $-NR^{16A}-$ ,  $-CO-$ ,  $-PR^{16A}-$  or  $-(POR^{16A})-$ ,

where

$R^{16A}$ ,  $R^{17A}$  and  $R^{18A}$  are identical or different, and are each independently of one another, hydrogen, halogen, a trimethylsilyl group, a  $C_1$ - $C_{10}$ -alkyl group, a  $C_1$ - $C_{10}$ -fluoroalkyl group, a  $C_6$ - $C_{10}$ -fluoroaryl group, a  $C_6$ - $C_{10}$ -aryl group, a  $C_1$ - $C_{10}$ -alkoxy group, a  $C_7$ - $C_{15}$ -alkylaryloxy group, a  $C_2$ - $C_{10}$ -alkenyl group, a  $C_7$ - $C_{40}$ -arylalkyl group, a  $C_8$ - $C_{40}$ -arylalkenyl group, or a  $C_7$ - $C_{40}$ -alkylaryl group, or two adjacent radicals together with the atoms connecting them form a saturated or unsaturated ring having from 4 to 15 carbon atoms;

$M^{2A}$  is silicon, germanium, or tin;

$A^A$  is  $-O-$ ,  $-S-$ ,  $-NR^{19A}-$ ,  $-PR^{19A}-$ ,  $-O-R^{19A}$ ,  $-NR^{19A}_2$ ,  $-PR^{19A}_2$ , or an unsubstituted, substituted or fused, heterocyclic ring system, where

$R^{19A}$  are identical or different, and are each independently of one another,  $C_1$ - $C_{10}$ -alkyl,  $C_6$ - $C_{15}$ -aryl,  $C_3$ - $C_{10}$ -cycloalkyl,  $C_7$ - $C_{18}$ -alkylaryl, or  $-Si(R^{20A})_3$ ;

$R^{20A}$  is hydrogen,  $C_1$ - $C_{10}$ -alkyl,  $C_6$ - $C_{15}$ -aryl which optionally bear  $C_1$ - $C_4$ -alkyl groups as substituents, or  $C_3$ - $C_{10}$ -cycloalkyl; and

$V^A$  is 1 or, if  $A^A$  is an unsubstituted, substituted or fused, heterocyclic ring system, 1 or 0

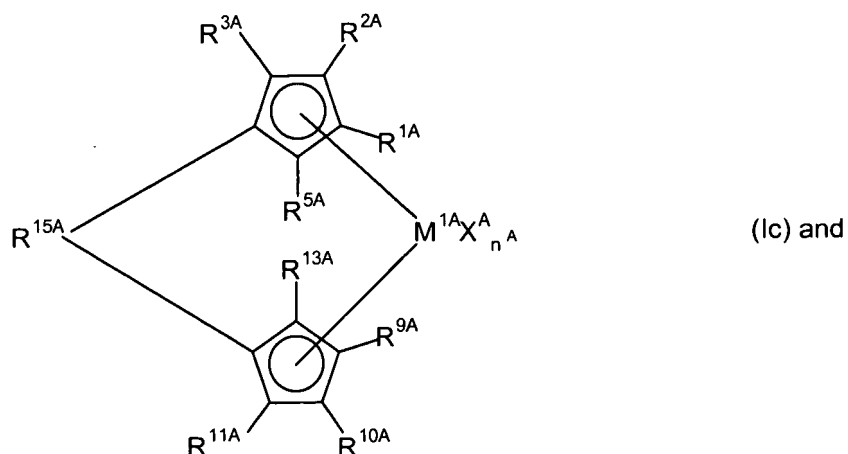
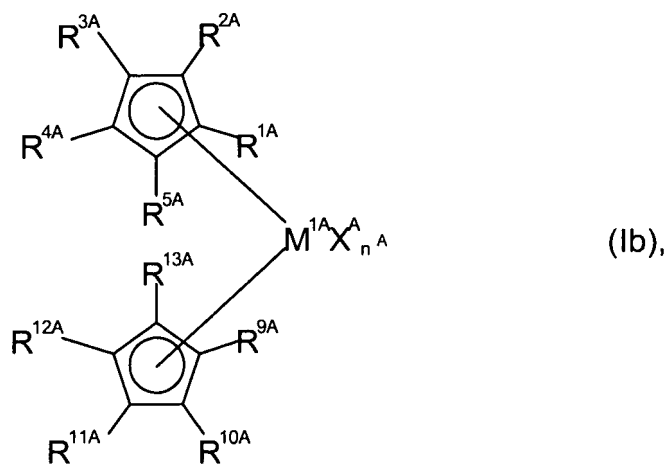
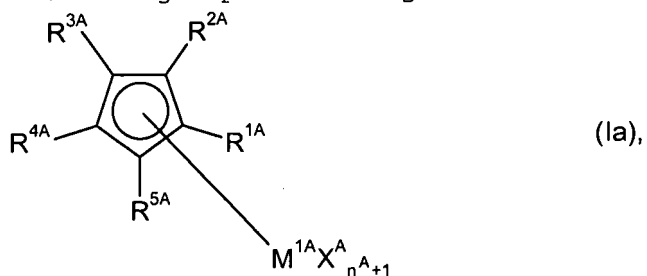
or  $R^{4A}$  and  $R^{12A}$  together form  $-R^{15A}-$ .

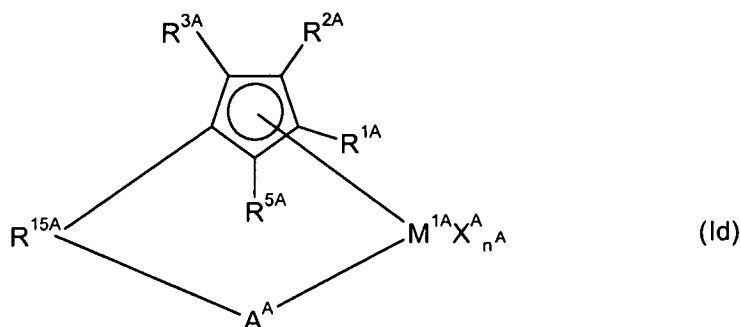
**32.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim 31, wherein

$X^A$  are identical, and are fluorine, chlorine, bromine,  $C_1$ - $C_7$ -alkyl or arylalkyl, or two  $X^A$  together form, a 1,3-diene ligand, or a biaryloxy group; and

$M^{2A}$  is silicon.

**33.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **31**, wherein the compound of formula (I) is selected from the group consisting of





wherein in formula (Ia)

- $M^{1A}$  is titanium or chromium;  
 $X^A$  is chlorine,  $C_1$ - $C_4$ -alkyl, phenyl, alkoxy, or aryloxy;  
 $n^A$  is 1 or 2; and  
 $R^{1A}$  to  $R^{5A}$  are each hydrogen, or  $C_1$ - $C_4$ -alkyl, or two adjacent  $R^{1A}$  to  $R^{5A}$  radicals together with the atoms connecting them form a substituted or unsubstituted, unsaturated six-membered ring;

wherein in formula (Ib)

- $M^{1A}$  is titanium, zirconium, hafnium, or chromium;  
 $X^A$  is chlorine,  $C_1$ - $C_4$ -alkyl, or benzyl, or two  $X^A$  radicals form a substituted or unsubstituted butadiene ligand;  
 $n^A$  is 1 or 2, with the proviso that if  $M^{1A}$  is chromium, then  $n^A$  is 0;  
 $R^{1A}$  to  $R^{5A}$  are each hydrogen,  $C_1$ - $C_8$ -alkyl,  $C_6$ - $C_{10}$ -aryl,  $-NR^{8A}_2$ ,  $-OSiR^{8A}_3$ ,  $-SiR^{8A}_3$ , or  $-Si(R^{8A})_3$ ; and  
 $R^{9A}$  to  $R^{13A}$  are each hydrogen,  $C_1$ - $C_8$ -alkyl,  $C_6$ - $C_{10}$ -aryl,  $-NR^{8A}_2$ ,  $-OSiR^{8A}_3$ ,  $-SiR^{8A}_3$ , or  $-Si(R^{8A})_3$ ;

or two  $R^{1A}$  to  $R^{5A}$  radicals and/or two  $R^{9A}$  to  $R^{13A}$  radicals together with the cyclopentadienyl ring form an indenyl or substituted indenyl system;

wherein in formula (Ic)

- $R^{1A}$  and  $R^{9A}$  are identical or different, and are each independently of one another, hydrogen, or a  $C_1$ - $C_{10}$ -alkyl group;  
 $R^{5A}$  and  $R^{13A}$  are identical or different, and are each independently of one another, hydrogen, methyl, ethyl, isopropyl, or tert-butyl;  
 $R^{3A}$  and  $R^{11A}$  are each  $C_1$ - $C_4$ -alkyl; and  
 $R^{2A}$  and  $R^{10A}$  are each hydrogen; or two adjacent  $R^{2A}$  and  $R^{3A}$

radicals, or two  $R^{10A}$  and  $R^{11A}$  radicals together form a saturated or unsaturated cyclic group comprising from 4 to 44 carbon atoms;

$R^{15A}$  is  $-M^{2A}R^{16A}R^{17A}-$ ,  $-CR^{16A}R^{17A}-CR^{16A}R^{17A}-$ ,  $-BR^{16A}-$ , or  $-BNR^{16A}R^{17A}-$ ;

$M^{1A}$  is titanium, zirconium, or hafnium; and

$X^A$  are identical or different and are each chlorine,  $C_1$ - $C_4$ -alkyl, benzyl, phenyl, or  $C_7$ - $C_{15}$ -alkylaryloxy;

wherein in formula (Id)

$M^{1A}$  is titanium, or zirconium;

$X^A$  is chlorine,  $C_1$ - $C_4$ -alkyl, or phenyl, or two  $X$  radicals together form a substituted or unsubstituted butadiene ligand;

$R^{15A}$  is  $-SiR^{16A}R^{17A}-$ , or  $-CR^{16A}R^{17A}-CR^{16A}R^{17A}-$ ; and

$A^A$  is  $-O-$ ,  $-S-$ , or  $-NR^{19A}-$ ;

$R^{1A}$  to  $R^{3A}$  and  $R^{5A}$  are each hydrogen,  $C_1$ - $C_{10}$ -alkyl,  $C_3$ - $C_{10}$ -cycloalkyl,  $C_6$ - $C_{15}$ -aryl, or  $-Si(R^{8A})_3$ , or two adjacent radicals form a cyclic group comprising from 4 to 12 carbon atoms.

**34.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **29**, wherein the component (A) is bis(cyclopentadienyl)zirconium dichloride,

bis(pentamethylcyclopentadienyl)zirconium dichloride,

bis(methylcyclopentadienyl)zirconium dichloride,

bis(ethylcyclopentadienyl)zirconium dichloride,

bis(n-butylcyclopentadienyl)zirconium dichloride,

bis(1-n-butyl-3-methylcyclopentadienyl)zirconium dichloride,

bis(indenyl)zirconium dichloride,

bis(tetrahydroindenyl)zirconium dichloride,

bis(trimethylsilylcyclopentadienyl)zirconium dichloride,

bis(cyclopentadienyl)zirconium dimethyl,

bis(pentamethylcyclopentadienyl)zirconium dimethyl,

bis(methylcyclopentadienyl)zirconium dimethyl,

bis(ethylcyclopentadienyl)zirconium dimethyl,

bis(n-butylcyclopentadienyl)zirconium dimethyl,

bis(1-n-butyl-3-methylcyclopentadienyl)zirconium dimethyl,

bis(indenyl)zirconium dimethyl,

bis(tetrahydroindenyl)zirconium didimethyl,

bis(trimethylsilylcyclopentadienyl)zirconium dimethyl,

dimethylsilanediyl(2-methyl-4-phenylindenyl)-(2,5-dimethyl-N-phenyl-4-

azapentalene)zirconium dichloride,  
dimethylsilanediylbis(2-methyl-4-phenyl-4-hydroazulenyl)zirconium  
dichloride,  
dimethylsilanediylbis(2-ethyl-4-phenyl-4-hydroazulenyl)zirconium  
dichloride,  
dimethylsilanediylbis(cyclopentadienyl)zirconium dichloride,  
dimethylsilanediylbis(indenyl)zirconium dichloride,  
dimethylsilanediylbis(tetrahydroindenyl)zirconium dichloride,  
ethylenebis(cyclopentadienyl)zirconium dichloride,  
ethylenebis(indenyl)zirconium dichloride,  
ethylenebis(tetrahydroindenyl)zirconium dichloride,  
tetramethylethylene-9-fluorenylcyclopentadienylzirconium dichloride,  
dimethylsilanediylbis(3-tert-butyl-5-methylcyclopentadienyl)zirconium  
dichloride,  
dimethylsilanediylbis(3-tert-butyl-5-ethylcyclopentadienyl)zirconium  
dichloride,  
dimethylsilanediylbis(2-methylindenyl)zirconium dichloride,  
dimethylsilanediylbis(2-isopropylindenyl)zirconium dichloride,  
dimethylsilanediylbis(2-tert-butylindenyl)zirconium dichloride,  
diethylsilanediylbis(2-methylindenyl)zirconium dibromide,  
dimethylsilanediylbis(3-methyl-5-methylcyclopentadienyl)zirconium  
dichloride,  
dimethylsilanediylbis(3-ethyl-5-isopropylcyclopentadienyl)zirconium  
dichloride,  
dimethylsilanediylbis(2-ethylindenyl)zirconium dichloride,  
dimethylsilanediylbis(2-methyl-4,5-benzindenyl)zirconium dichloride  
dimethylsilanediylbis(2-ethyl-4,5-benzindenyl)zirconium dichloride  
methylphenylsilanediylbis(2-methyl-4,5-benzindenyl)zirconium  
dichloride,  
methylphenylsilanediylbis(2-ethyl-4,5-benzindenyl)zirconium dichloride,  
diphenylsilanediylbis(2-methyl-4,5-benzindenyl)zirconium dichloride,  
diphenylsilanediylbis(2-ethyl-4,5-benzindenyl)zirconium dichloride,  
diphenylsilanediylbis(2-methylindenyl)hafnium dichloride,  
dimethylsilanediylbis(2-methyl-4-phenylindenyl)zirconium dichloride,  
dimethylsilanediylbis(2-ethyl-4-phenylindenyl)zirconium dichloride,  
dimethylsilanediylbis(2-methyl-4-(1-naphthyl)indenyl)zirconium  
dichloride,  
dimethylsilanediylbis(2-ethyl-4-(1-naphthyl)indenyl)zirconium  
dichloride,

dimethylsilanediyylbis(2-propyl-4-(1-naphthyl)indenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-i-butyl-4-(1-naphthyl)indenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-propyl-4-(9-phenanthryl)indenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-methyl-4-isopropylindenyl)zirconium dichloride,  
dimethylsilanediyylbis(2,7-dimethyl-4-isopropylindenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-methyl-4,6-diisopropylindenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-methyl-4-[p-  
trifluoromethylphenyl]indenyl)zirconium dichloride,  
dimethylsilanediyylbis(2-methyl-4-[3',5'-  
dimethylphenyl]indenyl)zirconium dichloride,  
dimethylsilanediyylbis(2-methyl-4-[4'-tert-butylphenyl]indenyl)zirconium  
dichloride,  
diethylsilanediyylbis(2-methyl-4-[4'-tert-butylphenyl]indenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-ethyl-4-[4'-tert-butylphenyl]indenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-propyl-4-[4'-tert-butylphenyl]indenyl)zirconium  
dichloride,  
dimethylsilanediyylbis(2-isopropyl-4-[4'-tert-  
butylphenyl]indenyl)zirconium dichloride,  
dimethylsilanediyylbis(2-n-butyl-4-[4'-tert-  
butylphenyl]indenyl)zirconium dichloride,  
dimethylsilanediyylbis(2-hexyl-4-[4'-tert-butylphenyl]indenyl)zirconium  
dichloride,  
dimethylsilanediyyl(2-isopropyl-4-phenylindenyl)-(2-methyl-4-  
phenylindenyl)zirconium dichloride,  
dimethylsilanediyyl(2-isopropyl-4-(1-naphthyl)indenyl)-(2-methyl-4-(1-  
naphthyl)indenyl)zirconium dichloride,  
dimethylsilanediyyl(2-isopropyl-4-[4'-tert-butylphenyl]indenyl)-(2-  
methyl-4-[4'-tert-butylphenyl]indenyl)zirconium dichloride,  
dimethylsilanediyyl(2-isopropyl-4-[4'-tert-butylphenyl]indenyl)-(2-  
ethyl-4-[4'-tert-butylphenyl]indenyl)zirconium dichloride,  
dimethylsilanediyyl(2-isopropyl-4-[4'-tert-butylphenyl]indenyl)-(2-

methyl-4-[3',5'-bis-tert-butylphenyl]indenyl)zirconium dichloride,  
dimethylsilanediyl(2-isopropyl-4-[4'-tert-butylphenyl]indenyl)-(2-methyl-4-[1'-naphthyl]indenyl)zirconium dichloride,  
ethylene(2-isopropyl-4-[4'-tert-butylphenyl]indenyl)-(2-methyl-4-[4'-tert-butylphenyl]indenyl)zirconium dichloride,  
di(2,6-di-i-propylphenyl)-2,3-dimethyldiazabutadienepalladium dichloride,  
di(di-i-propylphenyl)-2,3-dimethyldiazabutadienenickel dichloride,  
di(2,6-di-i-propylphenyl)-2,3-dimethyldiazabutadienedimethylpalladium,  
di(2,6-di-i-propylphenyl)-2,3-dimethyldiazabutadienedimethylnickel,  
di(2,6-dimethylphenyl)-2,3-dimethyldiazabutadienepalladium dichloride,  
di(2,6-dimethylphenyl)-2,3-dimethyldiazabutadienenickel dichloride,  
di(2,6-dimethylphenyl)-2,3-dimethyldiazabutadienedimethylpalladium,  
di(2,6-dimethylphenyl)-2,3-dimethyldiazabutadienedimethylnickel,  
di(2-methylphenyl)-2,3-dimethyldiazabutadienepalladium dichloride,  
di(2-methylphenyl)-2,3-dimethyldiazabutadienenickel dichloride,  
di(2-methylphenyl)-2,3-dimethyldiazabutadienedimethylpalladium,  
di(2-methylphenyl)-2,3-dimethyldiazabutadienedimethylnickel,  
diphenyl-2,3-dimethyldiazabutadienepalladium dichloride,  
diphenyl-2,3-dimethyldiazabutadienenickel dichloride,  
diphenyl-2,3-dimethyldiazabutadienedimethylpalladium,  
diphenyl-2,3-dimethyldiazabutadienedimethylnickel,  
di(2,6-dimethylphenyl)azanaphthenepalladium dichloride,  
di(2,6-dimethylphenyl)azanaphthenenickel dichloride,  
di(2,6-dimethylphenyl)azanaphthenedimethylpalladium,  
di(2,6-dimethylphenyl)azanaphthenedimethylnickel,  
1,1'-bipyridylpalladium dichloride,  
1,1'-bipyridylnickel dichloride,  
1,1'-bipyridyldimethylpalladium,  
1,1'-bipyridyldimethylnickel,  
1-(8-quinolyl)-2-methyl-4-methylcyclopentadienylchromium(III) dichloride,  
1-(8-quinolyl)-3-isopropyl-5-methylcyclopentadienylchromium(III) dichloride,  
1-(8-quinolyl)-3-tert-butyl-5-methylcyclopentadienylchromium(III) dichloride,  
1-(8-quinolyl)-2,3,4,5-tetramethylcyclopentadienylchromium(III) dichloride,  
1-(8-quinolyl)tetrahydroindenylchromium(III) dichloride,

1-(8-quinolyl)indenylchromium(III) dichloride,  
1-(8-quinolyl)-2-methylindenylchromium(III) dichloride,  
1-(8-quinolyl)-2-isopropylindenylchromium(III) dichloride,  
1-(8-quinolyl)-2-ethylindenylchromium(III) dichloride,  
1-(8-quinolyl)-2-tert-butylindenylchromium(III) dichloride,  
1-(8-quinolyl)benzindenylchromium(III) dichloride,  
1-(8-quinolyl)-2-methylbenzindenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))-2-methyl-4-methylcyclopentadienylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))-2,3,4,5-tetramethylcyclopentadienylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))tetrahydroindenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))indenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))-2-methylindenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))-2-isopropylindenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))-2-ethylindenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))-2-tert-butylindenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))benzindenylchromium(III) dichloride,  
1-(8-(2-methylquinolyl))-2-methylbenzindenylchromium(III) dichloride,  
[1,3,5-tri(methyl)-1,3,5-triazacyclohexane]chromium trichloride,  
[1,3,5-tri(ethyl)-1,3,5-triazacyclohexane]chromium trichloride,  
[1,3,5-tri(octyl)-1,3,5-triazacyclohexane]chromium trichloride,  
[1,3,5-tri(dodecyl)-1,3,5-triazacyclohexane]chromium trichloride,  
[1,3,5-tri(benzyl)-1,3,5-triazacyclohexane]chromium trichloride, or mixtures thereof.

**35.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **21**, wherein said organometallic compound of formula (V) is n-butyllithium, n-butyl-n-octylmagnesium, n-butyl-n-heptylmagnesium, triphenylaluminum, triisoprenaluminum, tri-n-octylaluminum, tri-n-hexylaluminum, tri-n-butylaluminum, triisobutylaluminum, tri-n-propylaluminum, tri-isopropylaluminum, triethylaluminum, trispentafluorophenylborane, trimethylaluminum, or mixtures thereof.

**36.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **34**, wherein said organometallic compound of formula (V) is n-butyllithium, n-butyl-n-octylmagnesium, n-butyl-n-heptylmagnesium, triphenylaluminum, triisoprenaluminum, tri-n-octylaluminum, tri-n-hexylaluminum, tri-n-butylaluminum, triisobutylaluminum, tri-n-propylaluminum, tri-isopropylaluminum, triethylaluminum, trispentafluorophenylborane, trimethylaluminum, or mixtures thereof.

**37.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **26**, wherein said organometallic

compound of formula (VI) is at least one borinic acid of formula  $R^4_2B(OH)_2$ , or at least one boronic acid of formula  $R^4B(OH)_2$ .

**38.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **21**, wherein said Lewis base is methylamine, aniline, dimethylamine, diethylamine, N-methylaniline, diphenylamine, trimethylamine, triethylamine, tripropylamine, tributylamine, N,N-dimethylaniline, N,N-diethylaniline, N,N-dimethylcyclohexylamine, benzylamine, N-benzyl dimethylamine, N-benzyl diethylamine, N-benzyl butylamine, N-benzyl-tert-butylamine, N'-benzyl-N,N-dimethylethylenediamine, N-benzylethylenediamine, N-benzylisopropylamine, N-benzylmethylamine, N-benzylethylamine, N-benzyl-1-phenylethylamine, N-benzyl-2-phenylethylamine, N-benzylpiperazine, or mixtures thereof.

**39.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **37**, wherein said Lewis base is methylamine, aniline, dimethylamine, diethylamine, N-methylaniline, diphenylamine, trimethylamine, triethylamine, tripropylamine, tributylamine, N,N-dimethylaniline, N,N-diethylaniline, N,N-dimethylcyclohexylamine, benzylamine, N-benzyl dimethylamine, N-benzyl diethylamine, N-benzyl butylamine, N-benzyl-tert-butylamine, N'-benzyl-N,N-dimethylethylenediamine, N-benzylethylenediamine, N-benzylisopropylamine, N-benzylmethylamine, N-benzylethylamine, N-benzyl-1-phenylethylamine, N-benzyl-2-phenylethylamine, N-benzylpiperazine, or mixtures thereof.

**40.** The process for preparing a catalyst solid for olefin polymerization as claimed in claim **21**, wherein in formula (V)  
M<sup>1</sup> is lithium, boron, magnesium, or aluminum; and  
R<sup>1</sup>, R<sup>2</sup>, and R<sup>3</sup> are each a C<sub>1</sub>-C<sub>10</sub>-alkyl.

IX. Evidence Appendix

Not applicable

X. Related Proceedings Appendix

Not applicable